HEARING CONSERVATION PROGRAM

City of Tempe, Arizona

February 2002

(Revised) August 2004

City of Tempe
Hearing Conservation Program

This document establishes the Hearing Conservation Program for all applicable Departments within the city government of Tempe, Arizona. Our goal is to ensure that our employees are protected from noise induced hearing loss and that we meet the requirements of the Occupational Noise Standard (29 CFR 1910.95).

Historically, noise induced hearing loss has been recognized as an occupational hazard. Hearing loss has been and continues to be a source of concern within all types of industry. Exposure occurs as a result of impulse or impact noises or noise from continuous sounds such as aircraft, engines, and machinery, etc. Long term exposure to excessive noise may result in permanent, irreversible hearing loss.

Noise induced hearing loss is a significant issue that requires considerable attention. Management is required to ensure that employees who are exposed to noise equal to or greater than the "Action Level" are included in this program. Administration of this program is the responsibility of the Environmental Health and Safety Section. The Program Administrator for this program is the Industrial Hygenist.

City of Tempe
Hearing Conservation Program

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I. PURPOSE AND SCOPE

The purpose of the City of Tempe Hearing Conservation Program is to establish policies and procedures designed to control employee exposure to occupational noise.

All departments that have employees who work in areas where noise levels equal or exceed an eight-hour time weighted average (TWA) "Action Level" of 85 dBA, or employees who are exposed to impact noise of 140 dBA, shall include those employees in a Hearing Conservation Program.

II. PROCEDURE

A. Permissible Noise Exposure Limits

Table 1 indicates the duration and sound levels to which employees may be exposed to occupational noise without experiencing hearing loss. Employees must not be exposed to impact noise greater than 140 dBA peak.

TABLE 1
PERMISSIBLE NOISE-EXPOSURE REQUIREMENTS

DURATION (hrs/day)	DOSE (%)	SOUND LEVELS (dBA)
8 **	33	85
8	100	90
6	100	92
4	100	95
3	100	97
2	100	100
1.5	100	102
1	100	105
0.5	100	110
0.33	100	112
0.25	100	115

** 85 dBA/8 hours = "Action Level" at which a Hearing Conservation Program is required.

B. Noise Control Measures

1. When noise levels equal or exceed a time-weighted average of 85 dBA for an eight hour day, a Hearing Conservation Program must be implemented. The program shall contain the following elements:

    a. Noise Monitoring
    b. Noise Control
    c. Audiometric Testing
    d. Hearing Protection
    e. Employee Education
    f. Record keeping

2. When employees are subjected to noise levels exceeding an eight-hour TWA of 90 dBA, feasible engineering controls and or administrative controls must be taken to reduce employee noise exposure.

C. Identification of High-Noise Areas

The Department Manager, or representative, shall report high noise areas to the Environmental Health and Safety Sections, Hearing Conservation Program Adminstrator (Program Administrator).

D. Area Monitoring

1. Noise surveys will be coordinated by the Program Administrator upon notification of potential high noise areas.

2. Affected employees, or their representatives, shall be provided an opportunity to observe any noise measurements.

3. The Hearing Conservation Program Administrator shall notify each employee, in writing, of the results of monitoring. Results of the monitoring shall be posted in the affected area for a period of at least one week.

4. If a noticeable change in either equipment or operation occurs, each department shall notify the Program Administrator so that additional noise monitoring may be conducted.

E. Personal Monitoring (Dosimetry)

1. Noise dosimetry will be performed if noise levels are suspected to exceed the 85 dBA TWA "Action Level".

2. Noise monitoring shall be conducted by an Industrial Hygienist.

3. All noise dosimetry results shall be posted in the work area easily accessible to affected employees for a period of five working days.

4. The affected department will be notified, in writing, of recommendations and required actions.

F. Sound Level Meters

1. All sound equipment and noise meters will be calibrated prior to and after noise surveys.

2. Any questions concerning equipment calibration shall be directed to the Program Administrator.

G. High Noise Area Inspections

1. Periodic inspections of high noise areas by the department will be performed to monitor the use of hearing protection and verify the presence of required postings.

2. The Program Administrator shall be notified of problem areas so that further evaluations can be scheduled.

H. Warning Signs and Posters

1. Signs and Occupational Noise Standard posters indicating equipment and areas of high noise shall be posted conspicuously to ensure that affected employees are aware of area requirements.

2. To ensure complete visibility, signs must be kept clean and unobstructed.

3. Departments shall be responsible for obtaining and posting required signs.

I. Hearing Protection Devices

1. If engineering controls cannot reduce noise exposure or administrative controls are not feasible, hearing protective devices shall be worn. Personal hearing protective devices shall be worn while engineering controls are being studied or evaluated.

2. Departments shall make hearing protective devices available to all employees exposed at or above the "Action Level" at no cost to employees. Hearing protective devices shall be replaced as necessary.

3. It is the direct responsibility of supervisors to ensure that employees properly use hearing protection whenever working in high noise environments.

4. Departments shall establish policies concerning hearing protection for other persons not specifically covered by this program (i.e., visitors).

5. Employees shall be given the opportunity to select their hearing protection from a variety of suitable hearing protective devices as specified by the Program Administrator.

6. Supervisors shall ensure that employees use only authorized hearing protection devices.

7. Supervisors are responsible to ensure that all unauthorized hearing protective devices are removed from City premises.

J. Audiometric Testing

1. The Program Administrator shall establish and maintain an audiometric testing program. Audiometric testing will be made available to all employees whose exposure equals or exceeds the "Action Level".

    a. All applicants will tested for hearing acuity as a standard part of the pre-employment examination.

    b. Annual audiometric examinations are given to all employees exposed to noise equal to or above the "Action Level", or where employees have been diagnosed with occupational hearing loss.

c. If the annual audiogram shows that an employee has suffered a standard threshold shift, the City of Tempe may obtain a retest within 30 days and consider the results of the retest as the annual audiogram.

2. Departments shall be responsible for scheduling their employees for annual audiometric testing and ensure that the appointments are kept.

3. Employees shall be notified of the need to avoid high levels of noise during a 14-hour period prior to audiometric testing.

4. It is the responsibility of the direct line supervisor to ensure that employees observe the 14-hour rule. Hearing protection may be used as a substitute for the requirement.

5. If a comparison of the annual audiogram to the baseline audiogram indicates a standard threshold shift has occurred, the employee shall be informed in writing within 20 days of that determination.

6. If this shift is determined to be work-related, management shall:

   a. Fit potentially exposed employees currently not using hearing protection with hearing protection, provide training in the protectors' proper care and use, and enforce wearing of hearing protection.

   b. Refit and retrain employees already using protection and provide hearing protection offering greater protection if necessary.

   c. Refer affected employee(s) for a clinical audiological evaluation or examination, as appropriate, if additional testing is necessary or there is a suspicion that a medical pathology is causing or aggravated by the wearing of hearing protection.

7. If the shift is determined to be non-work related:

   a. The employee shall be informed of he need for an otological examination if a medical pathology unrelated to the use of the hearing protection is suspected.

K. Employee Training

1. A training program will be administered under the guidance of the Program Administrator to all employees covered by this program.

2. Employees covered by this program shall receive annual training.

3. The Program Administrator shall maintain records of employee training. Individual records shall include:

    a. Employee name
    b. Employee number
    c. Date of training
    d. Course content
    e. Instructors name

4. All participants shall sign and attendance roster.

5. Training shall include the following:

    a. The effects of noise on hearing

    b. The purpose of hearing protective devices

    c. The advantages, disadvantages, and attenuation of various types of hearing protective devices.

    d. Instruction on selection, fitting, use, and care of hearing protective devices.

    e. The purpose of audiometric testing.

    f. An explanation of the audiometric test procedures.

L. Record Keeping

1. Records of audiograms will be retained for the duration of the affected employees employment, plus 30 years. These records shall be retained by the Environmental Health and Safety Section and the City Physician. These records will be made available upon request by the employee, employees' designated representative, or ADOSH.

2. Noise survey results will be retained for at least two years by the Environmental Health and Safety Section, and will be available for inspection by authorized personnel.

III. RESPONSIBILITIES

The City of Tempe has implemented this program to protect its employees. The Environmental Health and Safety Section is responsible for implementing this program and for coordinating training for supervisory personnel. Supervisors shall assist the Environmental Health and Safety Section in identifying those employees in their areas who may require inclusion in the City Hearing Conservation Program. Such employees shall include full-time, part-time, volunteer and temporary personnel.

A. Upper Management shall:

1. Ensure all supervisory management personnel are aware of the Hearing Conservation Program and its contents.

2. Appoint a Program Coordinator. The Program Administrator for this program is Mr. Scott Mosley from the Environmental Health and Safety Section.

3. Annually audit the program for compliance with the City Government's standards and with federal regulations. This audit will be completed in coordination with the Environmental Health and Safety Section.

B. Program Administrator Shall:

1. Review Hearing Conservation Program elements and operations with supervisors and managers to determine what areas (departments) and which employees may be exposed to excessive noise levels.

2. Coordinate audiometric testing, noise level monitoring, and employee training. Ensure that warning signs are posted in high noise areas (over 100 dBA).

3. Notify supervisors as soon as practical, of days and times for noise level monitoring, audiometric testing, and training.

4. Ensure that supervisors have informed affected employees of test dates and of minimum requirements for acceptable workplace noise.

5. Review test results for follow-up action within the operation and/or counseling of employees.

6. Ensure that supervisors train affected employees in the use and care of hearing protection devices and that they enforce the wearing of these devices in required areas.

7. Ensure up-to-date test results and training documentation are maintained on all employees in the Hearing Conservation Program.

8. Ensure that applicable OSHA regulations are either posted or otherwise available to employees on a daily basis.

C. Supervisors Shall:

1. With the assistance of the program administrator, identify all areas and/or employees who may be exposed to excessive noise levels.

2. Notify their employees of the days and times when noise level monitoring, training and/or audiometric testing will be performed.

3. Ensure that employees are trained in the use, cleaning and maintenance of hearing protection. Enforce the wearing of hearing protection in required areas, and forward all documentation to the program administrator.

4. Assist the Environmental Health and Safety Section with implementation of administrative and engineering controls within their respective areas. Include the Hearing Conservation Program Administrator in any decision to purchase new equipment capable of producing noise levels in excess of 85 dBA.

D. Employees Shall:

1. Observe and obey all established rules regarding hearing protection.

2. Use hearing protection AT ALL TIMES in designated areas.

3. Comply with the 14 hours minimum requirement without workplace noise (prior to audiometric testing).

4. Use, clean and properly maintain hearing protection devices.

5. Immediately inform the supervisor or the Program Administrator of any changes in equipment, procedures, or problems encountered with hearing protection.

6. Participate actively in training sessions.

GLOSSARY:

Action level - An 8-hour time-weighted average of 85 decibels measured on the A-scale, slow response, or equivalently, a dose of fifty percent.

Audiogram - A chart, graph, or table resulting from an audiometric test showing an individual's hearing threshold levels as a function of frequency.

Audiologist - A professional, specializing in the study and rehabilitation of hearing, who is certified by the American Speech-Language-Hearing Association or licensed by a state board of examiners.

Baseline audiogram - The audiogram against which future audiograms are compared.

Decibel (dB) - Unit of measurement of sound level.

Hertz (Hz) - Unit of measurement of frequency, numerically equal to cycles per second.

Medical pathology - A disorder or disease. For purposes of this regulation, a condition or disease affecting the ear, which should be treated by a physician specialist.

Noise dose - The amount of nose that an individual is exposed to. The ratio, expressed as a percentage, of (1) the time integral, over a stated time or event, of the 0.6 power of the measured SLOW exponential time-averaged, squared A-weighted sound pressure and (2) the product of the criterion duration (8 hours) and the 0.6 power of the squared sound pressure corresponding to the criterion sound level (90 dB).

Noise dosimeter - An instrument that integrates a function of sound pressure over a period of time in such a manner that it directly indicates a noise dose.

Otolaryngologist - A physician specializing in diagnosis and treatment of disorders of the ear, nose and throat.

Representative exposure - Measurements of an employee's noise dose or 8-hour time-weighted average sound level that the employers deem to be representative of the exposures of other employees in the workplace.

Sound level - Ten times the common logarithm of the ratio of the square of the measured A-weighted sound pressure to the square of the standard reference pressure of 20 micropascals.

Sound level meter - An instrument for the measurement of sound level.

Time-weighted average sound level - That sound level, which if constant over an 8-hour exposure, would result in the same noise dose as is measured.

EXAMPLE

EMPLOYEE NOTIFICATION LETTER

City of Tempe
Hearing Conservation Notification

This letter serves to notify you that noise monitoring was performed to measure the duration and intensity of occupational noise in your work environment (See Attached Noise Monitoring Survey). The results were compared to allowable exposure standards called PELs (Permissible Exposure Limits) established by OSHA. This PEL is calculated on a Time Weighted Average (TWA) over a normal 8-hour work shift. The results indicated that you exceed the PEL/TWA. Therefore, Water Utility Department employees who work with the equipment identified in the Noise Monitoring Survey are covered by the City of Tempe, Hearing Conservation Program.

Therefore, you will be required to receive annual audiometric hearing tests and training. Additionally, you are required to wear hearing protection. The use of hearing protective equipment provides an additional protective barrier between you and potentially high noise levels.

If you have any questions about the monitoring or wish to have additional monitoring performed, please contact me at 350-8877.

Scott Mosley
Hearing Conservation Program Administrator

POST FOR TEN WORKING DAYS

29 CFR 1910.95 "Occupational Noise Exposure"

(a) Protection against the effects of noise exposure shall be provided when the sound levels exceed those shown in Table G-16 when measured on the A scale of a standard sound level meter at slow response. When noise levels are determined by octave band analysis, the equivalent A-weighted sound level may be determined as follows:

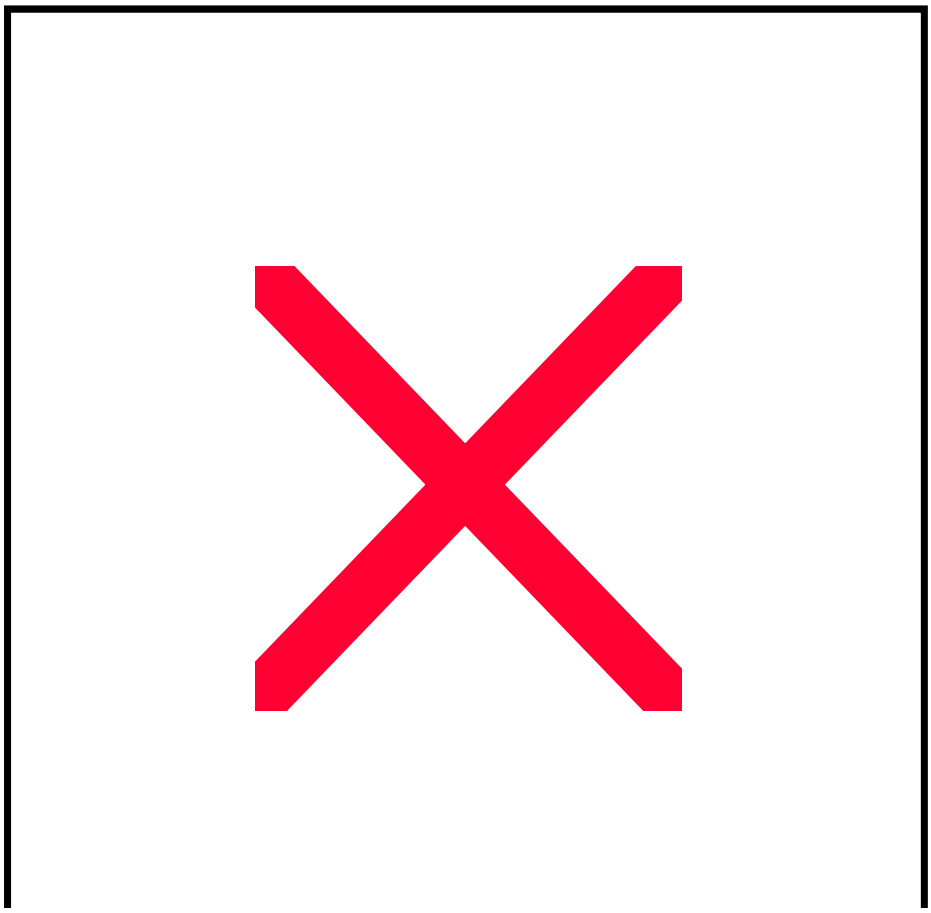

FIGURE G-9 - Equivalent A-Weighted Sound Level

Equivalent sound level contours. Octave band sound pressure levels may be converted to the equivalent A-weighted sound level by plotting them on this graph and noting the A-weighted sound level corresponding to the point of highest penetration into the sound level contours. This equivalent A-weighted sound level, which may differ from the actual A-weighted sound level of the noise, is used to determine exposure limits from Table 1.G-16.

(b)(1) When employees are subjected to sound exceeding those listed in Table G-16, feasible administrative or engineering controls shall be utilized. If such controls fail to reduce sound levels within the levels of Table G-16, personal protective equipment shall be provided and used to reduce sound levels within the levels of the table.

(b)(2) If the variations in noise level involve maxima at intervals of 1 second or less, it is to be considered continuous.

TABLE G-16 - PERMISSIBLE NOISE EXPOSURES [1]

Duration per day, hours	Sound level dBA slow response
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4 or less	115

Footnote[1] When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions: C(1)/T(1) + C(2)/T(2) C(n)/T(n) exceeds unity, then, the mixed exposure should be considered to exceed the limit value. Cn indicates the total time of exposure at a specified noise level, and Tn indicates the total time of exposure permitted at that level. Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

(c) "Hearing conservation program."

(c)(1) The employer shall administer a continuing, effective hearing conservation program, as described in paragraphs (c) through (o) of this section, whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level (TWA) of 85 decibels measured on the A scale (slow response) or, equivalently, a dose of fifty percent. For purposes of the hearing conservation program, employee noise exposures shall be computed in accordance with appendix A and Table G-16a, and without regard to any attenuation provided by the use of personal protective equipment.

(c)(2) For purposes of paragraphs (c) through (n) of this section, an 8-hour time-weighted average of 85 decibels or a dose of fifty percent shall also be referred to as the action level.

(d) "Monitoring."

(d)(1) When information indicates that any employee's exposure may equal or exceed an 8-hour time-weighted average of 85 decibels, the employer shall develop and implement a monitoring program.

(d)(1)(i) The sampling strategy shall be designed to identify employees for inclusion in the hearing conservation program and to enable the proper selection of hearing protectors.

(d)(1)(ii) Where circumstances such as high worker mobility, significant variations in sound level, or a significant component of impulse noise make area monitoring generally inappropriate, the employer shall use representative personal sampling to comply with the monitoring requirements of this paragraph unless the employer can show that area sampling produces equivalent results.

(d)(2)(i) All continuous, intermittent and impulsive sound levels from 80 decibels to 130 decibels shall be integrated into the noise measurements.

(d)(2)(ii) Instruments used to measure employee noise exposure shall be calibrated to ensure measurement accuracy.

(d)(3) Monitoring shall be repeated whenever a change in production, process, equipment or controls increases noise exposures to the extent that:

(d)(3)(i) Additional employees may be exposed at or above the action level; or

(d)(3)(ii) The attenuation provided by hearing protectors being used by employees may be rendered inadequate to meet the requirements of paragraph (j) of this section.

(e) "Employee notification." The employer shall notify each employee exposed at or above an 8-hour time-weighted average of 85 decibels of the results of the monitoring.

(f) "Observation of monitoring." The employer shall provide affected employees or their representatives with an opportunity to observe any noise measurements conducted pursuant to this section.

(g) "Audiometric testing program."

(g)(1) The employer shall establish and maintain an audiometric testing program as provided in this paragraph by making audiometric testing available to all employees whose exposures equal or exceed an 8-hour time-weighted average of 85 decibels.

(g)(2) The program shall be provided at no cost to employees.

(g)(3) Audiometric tests shall be performed by a licensed or certified audiologist, otolaryngologist, or other physician, or by a technician who is certified by the Council of Accreditation in Occupational Hearing Conservation, or who has satisfactorily demonstrated competence in administering audiometric examinations, obtaining valid audiograms, and properly using, maintaining and checking calibration and proper functioning of the audiometers being used. A technician who operates microprocessor audiometers does not need to be certified. A technician who performs audiometric tests must be responsible to an audiologist, otolaryngologist or physician.

(g)(4) All audiograms obtained pursuant to this section shall meet the requirements of Appendix C: "Audiometric Measuring Instruments."

(g)(5) "Baseline audiogram."

(g)(5)(i) Within 6 months of an employee's first exposure at or above the action level, the employer shall establish a valid baseline audiogram against which subsequent audiograms can be compared.

(g)(5)(ii) "Mobile test van exception." Where mobile test vans are used to meet the audiometric testing obligation, the employer shall obtain a valid baseline audiogram within 1 year of an employee's first exposure at or above the action level. Where baseline audiograms are obtained more than 6 months after the employee's first exposure at or above the action level, employees shall wearing hearing protectors for any period exceeding six months after first exposure until the baseline audiogram is obtained.

(g)(5)(iii) Testing to establish a baseline audiogram shall be preceded by at least 14 hours without exposure to workplace noise. Hearing protectors may be used as a substitute for the requirement that baseline audiograms be preceded by 14 hours without exposure to workplace noise.

(g)(5)(iv) The employer shall notify employees of the need to avoid high levels of non-occupational noise exposure during the 14-hour period immediately preceding the audiometric examination.

(g)(6) "Annual audiogram." At least annually after obtaining the baseline audiogram, the employer shall obtain a new audiogram for each employee exposed at or above an 8-hour time-weighted average of 85 decibels.

(g)(7) "Evaluation of audiogram."

(g)(7)(i) Each employee's annual audiogram shall be compared to that employee's baseline audiogram to determine if the audiogram is valid and if a standard threshold shift as defined in paragraph (g)(10) of this section has occurred. This comparison may be done by a technician.

(g)(7)(ii) If the annual audiogram shows that an employee has suffered a standard threshold shift, the employer may obtain a retest within 30 days and consider the results of the retest as the annual audiogram.

(g)(7)(iii) The audiologist, otolaryngologist, or physician shall review problem audiograms and shall determine whether there is a need for further evaluation. The employer shall provide to the person performing this evaluation the following information:

(g)(7)(iii)(A) A copy of the requirements for hearing conservation as set forth in paragraphs (c) through (n) of this section;

(g)(7)(iii)(B) The baseline audiogram and most recent audiogram of the employee to be evaluated;

(g)(7)(iii)(C) Measurements of background sound pressure levels in the audiometric test room as required in Appendix D: Audiometric Test Rooms.

(g)(7)(iii)(D) Records of audiometer calibrations required by paragraph (h)(5) of this section.

(g)(8) "Follow-up procedures."

(g)(8)(i) If a comparison of the annual audiogram to the baseline audiogram indicates a standard threshold shift as defined in paragraph (g)(10) of this section has occurred, the employee shall be informed of this fact in writing, within 21 days of the determination.

(g)(8)(ii) Unless a physician determines that the standard threshold shift is not work related or aggravated by occupational noise exposure, the employer shall ensure that the following steps are taken when a standard threshold shift occurs:

(g)(8)(ii)(A) Employees not using hearing protectors shall be fitted with hearing protectors, trained in their use and care, and required to use them.

(g)(8)(ii)(B) Employees already using hearing protectors shall be refitted and retrained in the use of hearing protectors and provided with hearing protectors offering greater attenuation if necessary.

(g)(8)(ii)(C) The employee shall be referred for a clinical audiological evaluation or an otological examination, as appropriate, if additional testing is necessary or if the employer suspects that a medical pathology of the ear is caused or aggravated by the wearing of hearing protectors.

(g)(8)(ii)(D) The employee is informed of the need for an otological examination if a medical pathology of the ear that is unrelated to the use of hearing protectors is suspected.

(g)(8)(iii) If subsequent audiometric testing of an employee whose exposure to noise is less than an 8-hour TWA of 90 decibels indicates that a standard threshold shift is not persistent, the employer:

(g)(8)(iii)(A) Shall inform the employee of the new audiometric interpretation; and

(g)(8)(iii)(B) May discontinue the required use of hearing protectors for that employee.

(g)(9) "Revised baseline." An annual audiogram may be substituted for the baseline audiogram when, in the judgment of the audiologist, otolaryngologist or physician who is evaluating the audiogram:

(g)(9)(i) The standard threshold shift revealed by the audiogram is persistent; or

(g)(9)(ii) The hearing threshold shown in the annual audiogram indicates significant improvement over the baseline audiogram.

(g)(10) "Standard threshold shift."

(g)(10)(i) As used in this section, a standard threshold shift is a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear.

(g)(10)(ii) In determining whether a standard threshold shift has occurred, allowance may be made for the contribution of aging (presbycusis) to the change in hearing level by correcting the annual audiogram according to the procedure described in Appendix F: "Calculation and Application of Age Correction to Audiograms."

(h) "Audiometric test requirements."

(h)(1) Audiometric tests shall be pure tone, air conduction, hearing threshold examinations, with test frequencies including as a minimum 500, 1000, 2000, 3000, 4000, and 6000 Hz. Tests at each frequency shall be taken separately for each ear.

(h)(2) Audiometric tests shall be conducted with audiometers (including microprocessor audiometers) that meet the specifications of, and are maintained and used in accordance with, American National Standard Specification for Audiometers, S3.6-1969, which is incorporated by reference as specified in Sec. 1910.6.

(h)(3) Pulsed-tone and self-recording audiometers, if used, shall meet the requirements specified in Appendix C: "Audiometric Measuring Instruments."

(h)(4) Audiometric examinations shall be administered in a room meeting the requirements listed in Appendix D: "Audiometric Test Rooms."

(h)(5) "Audiometer calibration."

(h)(5)(i) The functional operation of the audiometer shall be checked before each day's use by testing a person with known, stable hearing thresholds, and by listening to the audiometer's output to make sure that the output is free from distorted or unwanted sounds. Deviations of 10 decibels or greater require an acoustic calibration.

(h)(5)(ii) Audiometer calibration shall be checked acoustically at least annually in accordance with Appendix E: "Acoustic Calibration of Audiometers." Test frequencies below 500 Hz and above 6000 Hz may be omitted from this check. Deviations of 15 decibels or greater require an exhaustive calibration.

(h)(5)(iii) An exhaustive calibration shall be performed at least every two years in accordance with sections 4.1.2; 4.1.3.; 4.1.4.3; 4.2; 4.4.1; 4.4.2; 4.4.3; and 4.5 of the American National Standard Specification for Audiometers, S3.6-1969. Test frequencies below 500 Hz and above 6000 Hz may be omitted from this calibration.

(i) "Hearing protectors."

(i)(1) Employers shall make hearing protectors available to all employees exposed to an 8-hour time-weighted average of 85 decibels or greater at no cost to the employees. Hearing protectors shall be replaced as necessary.

(i)(2) Employers shall ensure that hearing protectors are worn:

(i)(2)(i) By an employee who is required by paragraph (b)(1) of this section to wear personal protective equipment; and

(i)(2)(ii) By any employee who is exposed to an 8-hour time-weighted average of 85 decibels or greater, and who:

(i)(2)(ii)(A) Has not yet had a baseline audiogram established pursuant to paragraph (g)(5)(ii); or

(i)(2)(ii)(B) Has experienced a standard threshold shift.

(i)(3) Employees shall be given the opportunity to select their hearing protectors from a variety of suitable hearing protectors provided by the employer.

(i)(4) The employer shall provide training in the use and care of all hearing protectors provided to employees.

(i)(5) The employer shall ensure proper initial fitting and supervise the correct use of all hearing protectors.

(j) "Hearing protector attenuation."

(j)(1) The employer shall evaluate hearing protector attenuation for the specific noise environments in which the protector will be used. The employer shall use one of the evaluation methods described in Appendix B: "Methods for Estimating the Adequacy of Hearing Protection Attenuation."

(j)(2) Hearing protectors must attenuate employee exposure at least to an 8-hour time-weighted average of 90 decibels as required by paragraph (b) of this section.

(j)(3) For employees who have experienced a standard threshold shift, hearing protectors must attenuate employee exposure to an 8-hour time-weighted average of 85 decibels or below.

(j)(4) The adequacy of hearing protector attenuation shall be re-evaluated whenever employee noise exposures increase to the extent that the hearing protectors provided may no longer provide adequate attenuation. The employer shall provide more effective hearing protectors where necessary.

(k) "Training program."

(k)(1) The employer shall institute a training program for all employees who are exposed to noise at or above an 8-hour time-weighted average of 85 decibels, and shall ensure employee participation in such program.

(k)(2) The training program shall be repeated annually for each employee included in the hearing conservation program. Information provided in the training program shall be updated to be consistent with changes in protective equipment and work processes.

(k)(3) The employer shall ensure that each employee is informed of the following:

(k)(3)(i) The effects of noise on hearing;

(k)(3)(ii) The purpose of hearing protectors, the advantages, disadvantages, and attenuation of various types, and instructions on selection, fitting, use, and care; and

(k)(3)(iii) The purpose of audiometric testing, and an explanation of the test procedures.

(l) "Access to information and training materials."

(l)(1) The employer shall make available to affected employees or their representatives copies of this standard and shall also post a copy in the workplace.

(l)(2) The employer shall provide to affected employees any informational materials pertaining to the standard that are supplied to the employer by the Assistant Secretary.

(l)(3) The employer shall provide, upon request, all materials related to the employer's training and education program pertaining to this standard to the Assistant Secretary and the Director.

(m) "Recordkeeping"

(m)(1) "Exposure measurements." The employer shall maintain an accurate record of all employee exposure measurements required by paragraph (d) of this section.

(m)(2) "Audiometric tests."

(m)(2)(i) The employer shall retain all employee audiometric test records obtained pursuant to paragraph (g) of this section:

(m)(2)(ii) This record shall include:

(m)(2)(ii)(A) Name and job classification of the employee;

(m)(2)(ii)(B) Date of the audiogram;

(m)(2)(ii)(C) The examiner's name;

(m)(2)(ii)(D) Date of the last acoustic or exhaustive calibration of the audiometer; and

(m)(2)(ii)(E) Employee's most recent noise exposure assessment.

(m)(2)(ii)(F) The employer shall maintain accurate records of the measurements of the background sound pressure levels in audiometric test rooms.

(m)(3) "Record retention." The employer shall retain records required in this paragraph (m) for at least the following periods.

(m)(3)(i) Noise exposure measurement records shall be retained for two years.

(m)(3)(ii) Audiometric test records shall be retained for the duration of the affected employee's employment.

(m)(4) "Access to records." All records required by this section shall be provided upon request to employees, former employees, representatives designated by the individual employee, and the Assistant Secretary. The provisions of 29 CFR 1910.20 (a)-(e) and (g)- apply to access to records under this section.

(m)(5) "Transfer of records." If the employer ceases to do business, the employer shall transfer to the successor employer all records required to be maintained by this section, and the successor employer shall retain them for the remainder of the period prescribed in paragraph (m)(3) of this section.

(n) "Appendices."

(n)(1) Appendices A, B, C, D, and E to this section are incorporated as part of this section and the contents of these appendices are mandatory.

(n)(2) Appendices F and G to this section are informational and are not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

(o) "Exemptions." Paragraphs (c) through (n) of this section shall not apply to employers engaged in oil and gas well drilling and servicing operations.

(p) "Startup date." Baseline audiograms required by paragraph (g) of this section shall be completed by March 1, 1984.

[39 FR 23502, June 27, 1974, as amended at 46 FR 4161, Jan. 16, 1981; 46 FR 62845, Dec. 29, 1981; 48 FR 9776, Mar. 8, 1983; 48 FR 29687, June 28, 1983; 54 FR 24333, June 7, 1989; 61 FR 5507, Feb. 13, 1996; 61 FR 9227, March 7, 1996]

Appendix A - Noise exposure computation

This Appendix is Mandatory

I. Computation of Employee Noise Exposure

(1) Noise dose is computed using Table G-16a as follows:

(i) When the sound level, L, is constant over the entire work shift, the noise dose, D, in percent, is given by: D=100 C/T where C is the total length of the work day, in hours, and T is the reference duration corresponding to the measured sound level, L, as given in Table G-16a or by the formula shown as a footnote to that table.

(ii) When the workshift noise exposure is composed of two or more periods of noise at different levels, the total noise dose over the work day is given by:

$$D = 100 (C(1)/T(1) + C(2)/T(2) + ... + C(n)/T(n)),$$

where C(n) indicates the total time of exposure at a specific noise level, and T(n) indicates the reference duration for that level as given by Table G-16A.

(2) The eight-hour time-weighted average sound level (TWA), in decibels, may be computed from the dose, in percent, by means of the formula: TWA = 16.61 log(10) (D/100) + 90. For an eight-hour workshift with the noise level constant over the entire shift, the TWA is equal to the measured sound level.

(3) A table relating dose and TWA is given in Section II.

TABLE G-16A

A-weighted sound level, L (decibel)	Reference duration, T (hour)
80	32
81	27.9
82	24.3
83	21.1
84	18.4
85	16
86	13.9
87	12.1
88	10.6
89	9.2
90	8
91	7.0
92	6.1
93	5.3
94	4.6
95	4.0
96	3.5
97	3.0
98	2.6
99	2.3
100	2
101	1.7
102	1.5
103	1.3
104	1.1
105	1.0
106	0.87
107	0.76
108	0.66
109	0.57
110	0.5
111	0.44
112	0.38
113	0.33
114	0.29
115	0.25
116	0.22
117	0.19
118	0.16
119	0.14
120	0.125
121	0.11
122	0.095
123	0.082
124	0.072
125	0.063
126	0.054
127	0.047
128	0.041

129	0.036
130	0.031

In the above table the reference duration, T, is computed by:

$$T = \frac{8}{2^{(L - 90)/5)}}$$

where L is the measured A-weighted sound level.

II. Conversion Between "Dose" and "8-Hour Time-Weighted Average" Sound Level

Compliance with paragraphs (c)-(r) of this regulation is determined by the amount of exposure to noise in the workplace. The amount of such exposure is usually measured with an audiodosimeter, which gives a readout in terms of "dose." In order to better understand the requirements of the amendment, dosimeter readings can be converted to an "8-hour time-weighted average sound level." (TWA).

In order to convert the reading of a dosimeter into TWA, see Table A-1, below. This table applies to dosimeters that are set by the manufacturer to calculate dose or percent exposure according to the relationships in Table G-16a. So, for example, a dose of 91 percent over an eight hour day results in a TWA of 89.3 dB, and, a dose of 50 percent corresponds to a TWA of 85 dB.

If the dose as read on the dosimeter is less than or greater than the values found in Table A-1, the TWA may be calculated by using the formula: TWA = 16.61 log(10) (D/100) + 90 where TWA=8-hour time-weighted average sound level and D = accumulated dose in percent exposure.

TABLE A-1 - CONVERSION FROM "PERCENT NOISE EXPOSURE" OR "DOSE" TO TIME-WEIGHTED AVERAGE SOUND LEVEL" (TWA)

Dose or percent noise exposure	TWA
10	73.4
15	76.3
20	78.4
25	80.0
30	81.3
35	82.4
40	83.4
45	84.2
50	85.0
55	85.7
60	86.3
65	86.9
70	87.4
75	87.9
80	88.4
81	88.5
82	88.6
83	88.7
84	88.7
85	88.8
86	88.9
87	89.0
88	89.1
89	89.2
90	89.2
91	89.3
92	89.4
93	89.5
94	89.6
95	89.6
96	89.7
97	89.8
98	89.9
99	89.9
100	90.0
101	90.1
102	90.1
103	90.2
104	90.3
105	90.4
106	90.4
107	90.5
108	90.6
109	90.6
110	90.7
111	90.8
112	90.8
113	90.9
114	90.9
115	91.1
116	91.1

Dose or percent noise exposure	TWA
125	91.6
130	91.9
135	92.2
140	92.4
145	92.7
150	92.9
155	93.2
160	93.4
165	93.6
170	93.8
175	94.0
180	94.2
185	94.4
190	94.6
195	94.8
200	95.0
210	95.4
220	95.7
230	96.0
240	96.3
250	96.6
260	96.9
270	97.2
280	97.4
290	97.7
300	97.9
310	98.2
320	98.4
330	98.6
340	98.8
350	99.0
360	99.2
370	99.4
380	99.6
390	99.8
400	100.0
410	100.2
420	100.4
430	100.5
440	100.7
450	100.8
460	101.0
470	101.2
480	101.3
490	101.5
500	101.6
510	101.8
520	101.9
530	102.0
540	102.2
550	102.3

Dose or percent noise exposure	TWA
600	102.9
610	103.0
620	103.2
630	103.3
640	103.4
650	103.5
660	103.6
670	103.7
680	103.8
690	103.9
700	104.0
710	104.1
720	104.2
730	104.3
740	104.4
750	104.5
760	104.6
770	104.7
780	104.8
790	104.9
800	105.0
810	105.1
820	105.2
830	105.3
840	105.4
850	105.4
860	105.5
870	105.6
880	105.7
890	105.8
900	105.8
910	105.9
920	106.0
930	106.1
940	106.2
950	106.2
960	106.3
970	106.4
980	106.5
990	106.5
999	106.6

117	91.1	560	102.4
118	91.2	570	102.6
119	91.3	580	102.7
120	91.3	590	102.8

Appendix B - Methods for estimating the adequacy of hearing protector attenuation

This Appendix is Mandatory

For employees who have experienced a significant threshold shift, hearing protector attenuation must be sufficient to reduce employee exposure to a TWA of 85 dB. Employers must select one of the following methods by which to estimate the adequacy of hearing protector attenuation.

The most convenient method is the Noise Reduction Rating (NRR) developed by the Environmental Protection Agency (EPA). According to EPA regulation, the NRR must be shown on the hearing protector package. The NRR is then related to an individual worker's noise environment in order to assess the adequacy of the attenuation of a given hearing protector. This appendix describes four methods of using the NRR to determine whether a particular hearing protector provides adequate protection within a given exposure environment. Selection among the four procedures is dependent upon the employer's noise measuring instruments.

Instead of using the NRR, employers may evaluate the adequacy of hearing protector attenuation by using one of the three methods developed by the National Institute for Occupational Safety and Health (NIOSH), which are described in the "List of Personal Hearing Protectors and Attenuation Data," HEW Publication No. 76-120, 1975, pages 21-37. These methods are known as NIOSH methods No. 1, No. 2 and No. 3. The NRR described below is a simplification of NIOSH method No. 2. The most complex method is NIOSH method No. 1, which is probably the most accurate method since it uses the largest amount of spectral information from the individual employee's noise environment. As in the case of the NRR method described below, if one of the NIOSH methods is used, the selected method must be applied to an individual's noise environment to assess the adequacy of the attenuation. Employers should be careful to take a sufficient number of measurements in order to achieve a representative sample for each time segment.

NOTE: The employer must remember that calculated attenuation values reflect realistic values only to the extent that the protectors are properly fitted and worn.

When using the NRR to assess hearing protector adequacy, one of the following methods must be used:

(i) When using a dosimeter that is capable of C-weighted measurements:

- **(A)** Obtain the employee's C-weighted dose for the entire workshift, and convert to TWA (see appendix A, II).
- **(B)** Subtract the NRR from the C-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

(ii) When using a dosimeter that is not capable of C-weighted measurements, the following method may be used:

(A) Convert the A-weighted dose to TWA (see appendix A).
(B) Subtract 7 dB from the NRR.
(C) Subtract the remainder from the A-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

(iii) When using a sound level meter set to the A-weighting network:

(A) Obtain the employee's A-weighted TWA.
(B) Subtract 7 dB from the NRR, and subtract the remainder from the A-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

(iv) When using a sound level meter set on the C-weighting network:

(A) Obtain a representative sample of the C-weighted sound levels in the employee's environment.
(B) Subtract the NRR from the C-weighted average sound level to obtain the estimated A-weighted TWA under the ear protector.

(v) When using area monitoring procedures and a sound level meter set to the A-weighing network.

(A) Obtain a representative sound level for the area in question.
(B) Subtract 7 dB from the NRR and subtract the remainder from the A-weighted sound level for that area.

(vi) When using area monitoring procedures and a sound level meter set to the C-weighting network:

(A) Obtain a representative sound level for the area in question.
(B) Subtract the NRR from the C-weighted sound level for that area.

Appendix C - Audiometric measuring instruments

This Appendix is Mandatory

1. In the event that pulsed-tone audiometers are used, they shall have a tone on-time of at least 200 milliseconds.

2. Self-recording audiometers shall comply with the following requirements:

(A) The chart upon which the audiogram is traced shall have lines at positions corresponding to all multiples of 10 dB hearing level within the intensity range spanned by the audiometer. The lines shall be equally spaced and shall be separated by at least 1/4 inch. Additional increments are optional. The audiogram pen tracings shall not exceed 2 dB in width.

(B) It shall be possible to set the stylus manually at the 10-dB increment lines for calibration purposes.

(C) The slewing rate for the audiometer attenuator shall not be more than 6 dB/sec except that an initial slewing rate greater than 6 dB/sec is permitted at the beginning of each new test frequency, but only until the second subject response.

(D) The audiometer shall remain at each required test frequency for 30 seconds (+ or - 3 seconds). The audiogram shall be clearly marked at each change of frequency and the actual frequency change of the audiometer shall not deviate from the frequency boundaries marked on the audiogram by more than + or - 3 seconds.

(E) It must be possible at each test frequency to place a horizontal line segment parallel to the time axis on the audiogram, such that the audiometric tracing crosses the line segment at least six times at that test frequency. At each test frequency the threshold shall be the average of the midpoints of the tracing excursions.

Appendix D - Audiometric Test Rooms

This Appendix is Mandatory

Rooms used for audiometric testing shall not have background sound pressure levels exceeding those in Table D-1 when measured by equipment conforming at least to the Type 2 requirements of American National Standard Specification for Sound Level Meters, S1.4-1971 (R1976), and to the Class II requirements of American National Standard Specification for Octave, Half-Octave, and Third-Octave Band Filter Sets, S1.11-1971 (R1976).

TABLE D-1 - Maximum allowable octave-band sound pressure levels for audiometric test rooms.

Octave-band center frequency (Hz)	500	1000	2000	4000	8000
Sound pressure level (dB)	40	40	47	57	62

Appendix E - Acoustic Calibration of Audiometers

This Appendix is Mandatory

Audiometer calibration shall be checked acoustically, at least annually, according to the procedures described in this appendix. The equipment necessary to perform these measurements is a sound level meter, octave-band filter set, and a National Bureau of Standards 9A coupler. In making these measurements, the accuracy of the calibrating equipment shall be sufficient to determine that the audiometer is within the tolerances permitted by American Standard Specification for Audiometers, S3.6-1969.

(1) "Sound Pressure Output Check"

- **A.** Place the earphone coupler over the microphone of the sound level meter and place the earphone on the coupler.
- **B.** Set the audiometer's hearing threshold level (HTL) dial to 70 dB.
- **C.** Measure the sound pressure level of the tones at each test frequency from 500 Hz through 6000 Hz for each earphone.
- **D.** At each frequency the readout on the sound level meter should correspond to the levels in Table E-1 or Table E-2, as appropriate, for the type of earphone, in the column entitled "sound level meter reading."

(2) "Linearity Check"

- **A.** With the earphone in place, set the frequency to 1000 Hz and the HTL dial on the audiometer to 70 dB.
- **B.** Measure the sound levels in the coupler at each 10-dB decrement from 70 dB to 10 dB, noting the sound level meter reading at each setting.
- **D.** For each 10-dB decrement on the audiometer the sound level meter should indicate a corresponding 10 dB decrease.
- **D.** This measurement may be made electrically with a voltmeter connected to the earphone terminals.

(3) "Tolerances"

When any of the measured sound levels deviate from the levels in Table E-1 or Table E-2 by + or - 3 dB at any test frequency between 500 and 3000 Hz, 4 dB at 4000 Hz, or 5 dB at 6000 Hz, an exhaustive calibration is advised. An exhaustive calibration is required if the deviations are greater than 15 dB or greater at any test frequency.

TABLE E-1 - Reference threshold levels for telephonics - TDH-39 Earphones.

Frequency (Hz)	Reference threshold level for TDH-39 earphones (dB)	Sound level meter reading (dB)
500	11.5	81.5
1000	7	77
2000	9	79
3000	10	80
4000	9.5	79.5
6000	15.5	85.5

TABLE E-2 - Reference threshold levels for telephonics TDH - 49 Earphones.

Frequency (Hz)	Reference threshold level for TDH-49 earphones (dB)	Sound level meter reading (dB)
500	13.5	83.5
1000	7.5	77.5
2000	11	81.0
3000	9.5	79.5
4000	10.5	80.5
6000	13.5	83.5

Appendix F - Calculations and application of age corrections to audiograms

This Appendix Is Non-Mandatory

In determining whether a standard threshold shift has occurred, allowance may be made for the contribution of aging to the change in hearing level by adjusting the most recent audiogram. If the employer chooses to adjust the audiogram, the employer shall follow the procedure described below. This procedure and the age correction tables were developed by the National Institute for Occupational Safety and Health in the criteria document entitled "Criteria for a Recommended Standard . . . Occupational Exposure to Noise," ((HSM)-11001).

For each audiometric test frequency;

(i) Determine from Tables F-1 or F-2 the age correction values for the employee by:

(A) Finding the age at which the most recent audiogram was taken and recording the corresponding values of age corrections at 1000 Hz through 6000 Hz;

(B) Finding the age at which the baseline audiogram was taken and recording the corresponding values of age corrections at 1000 Hz through 6000 Hz.

(ii) Subtract the values found in step (i)(B) from the value found in step (i)(A).

(iii) The differences calculated in step (ii) represented that portion of the change in hearing that may be due to aging.

EXAMPLE: Employee is a 32-year-old male. The audiometric history for his right ear is shown in decibels below.

Employee's Age	Audiometric Test Frequency (Hz)				
	1000	2000	3000	4000	6000
26	10	5	5	10	5
*27	0	0	0	5	5
28	0	0	0	10	5
29	5	0	5	15	5
30	0	5	10	20	10
31	5	10	20	15	15
*32	5	10	10	25	20

The audiogram at age 27 is considered the baseline since it shows the best hearing threshold levels. Asterisks have been used to identify the baseline and most recent audiogram. A threshold shift of 20 dB exists at 4000 Hz between the audiograms taken at ages 27 and 32.

(The threshold shift is computed by subtracting the hearing threshold at age 27, which was 5, from the hearing threshold at age 32, which is 25). A retest audiogram has confirmed this shift. The contribution of aging to this change in hearing may be estimated in the following manner:

Go to Table F-1 and find the age correction values (in dB) for 4000 Hz at age 27 and age 32.

	Frequency (Hz)				
	1000	**2000**	**3000**	**4000**	**6000**
Age 32	6	5	7	10	14
Age 27	5	4	6	7	11
Difference	1	1	1	3	3

The difference represents the amount of hearing loss that may be attributed to aging in the time period between the baseline audiogram and the most recent audiogram. In this example, the difference at 4000 Hz is 3 dB. This value is subtracted from the hearing level at 4000 Hz, which in the most recent audiogram is 25, yielding 22 after adjustment. Then the hearing threshold in the baseline audiogram at 4000 Hz (5) is subtracted from the adjusted annual audiogram hearing threshold at 4000 Hz (22). Thus the age-corrected threshold shift would be 17 dB (as opposed to a threshold shift of 20 dB without age correction).

TABLE F-1 - Age Correction Values in Decibels for Males

Years	Audiometric Test Frequency (Hz)				
	1000	2000	3000	4000	6000
20 or younger	5	3	4	5	8
21	5	3	4	5	8
22	5	3	4	5	8
23	5	3	4	6	9
24	5	3	5	6	9
25	5	3	5	7	10
26	5	4	5	7	10
27	5	4	6	7	11
28	6	4	6	8	11
29	6	4	6	8	12
30	6	4	6	9	12
31	6	4	7	9	13
32	6	5	7	10	14
33	6	5	7	10	14
34	6	5	8	11	15
35	7	5	8	11	15
36	7	5	9	12	16
37	7	6	9	12	17
38	7	6	9	13	17
39	7	6	10	14	18
40	7	6	10	14	19
41	7	6	10	14	20
42	8	7	11	16	20
43	8	7	12	16	21
44	8	7	12	17	22
45	8	7	13	18	23
46	8	8	13	19	24
47	8	8	14	19	24
48	9	8	14	20	25
49	9	9	15	21	26
50	9	9	16	22	27
51	9	9	16	23	28
52	9	10	17	24	29
53	9	10	18	25	30
54	10	10	18	26	31
55	10	11	19	27	32
56	10	11	20	28	34
57	10	11	21	29	35
58	10	12	22	31	36
59	11	12	22	32	37
60 or older	11	13	23	33	38

TABLE F-2 - Age Correction Values in Decibels for Females

Years	Audiometric Test Frequency (Hz)				
	1000	2000	3000	4000	6000
20 or younger	7	4	3	3	6
21	7	4	4	3	6
22	7	4	4	4	6
23	7	5	4	4	7
24	7	5	4	4	7
25	8	5	4	4	7
26	8	5	5	4	8
27	8	5	5	5	8
28	8	5	5	5	8
29	8	5	5	5	9
30	8	6	5	5	9
31	8	6	6	5	9
32	9	6	6	6	10
33	9	6	6	6	10
34	9	6	6	6	10
35	9	6	7	7	11
36	9	7	7	7	11
37	9	7	7	7	12
38	10	7	7	7	12
39	10	7	8	8	12
40	10	7	8	8	13
41	10	8	8	8	13
42	10	8	9	9	13
43	11	8	9	9	14
44	11	8	9	9	14
45	11	8	10	10	15
46	11	9	10	10	15
47	11	9	10	11	16
48	12	9	11	11	16
49	12	9	11	11	16
50	12	10	11	12	17
51	12	10	12	12	17
52	12	10	12	13	18
53	13	10	13	13	18
54	13	11	13	14	19
55	13	11	14	14	19
56	13	11	14	15	20
57	13	11	15	15	20
58	14	12	15	16	21
59	14	12	16	16	21
60 or older	14	12	16	17	22

Appendix G - Monitoring Noise Levels Non-mandatory Informational Appendix

This appendix provides information to help employers comply with the noise monitoring obligations that are part of the hearing conservation amendment.

WHAT IS THE PURPOSE OF NOISE MONITORING?

This revised amendment requires that employees be placed in a hearing conservation program if they are exposed to average noise levels of 85 dB or greater during an 8 hour workday. In order to determine if exposures are at or above this level, it may be necessary to measure or monitor the actual noise levels in the workplace and to estimate the noise exposure or "dose" received by employees during the workday.

WHEN IS IT NECESSARY TO IMPLEMENT A NOISE MONITORING PROGRAM?

It is not necessary for every employer to measure workplace noise. Noise monitoring or measuring must be conducted only when exposures are at or above 85 dB. Factors which suggest that noise exposures in the workplace may be at this level include employee complaints about the loudness of noise, indications that employees are losing their hearing, or noisy conditions which make normal conversation difficult. The employer should also consider any information available regarding noise emitted from specific machines. In addition, actual workplace noise measurements can suggest whether or not a monitoring program should be initiated.

HOW IS NOISE MEASURED?

Basically, there are two different instruments to measure noise exposures: the sound level meter and the dosimeter. A sound level meter is a device that measures the intensity of sound at a given moment. Since sound level meters provide a measure of sound intensity at only one point in time, it is generally necessary to take a number of measurements at different times during the day to estimate noise exposure over a workday. If noise levels fluctuate, the amount of time noise remains at each of the various measured levels must be determined.

To estimate employee noise exposures with a sound level meter it is also generally necessary to take several measurements at different locations within the workplace. After appropriate sound level meter readings are obtained, people sometimes draw "maps" of the sound levels within different areas of the workplace. By using a sound level "map" and information on employee locations throughout the day, estimates of individual exposure levels can be developed. This measurement method is generally referred to as "area" noise monitoring.

A dosimeter is like a sound level meter except that it stores sound level measurements and integrates these measurements over time, providing an average noise exposure reading for a given period of time, such as an 8-hour workday. With a dosimeter, a microphone is attached to the employee's clothing and the exposure measurement is simply read at the end of the desired time period. A reader may be used to read-out the dosimeter's measurements. Since the dosimeter is worn by the employee, it measures noise levels in those locations in which the employee travels. A sound level meter can also be positioned within the immediate vicinity of the exposed worker to obtain an individual exposure estimate. Such procedures are generally referred to as "personal" noise monitoring.

Area monitoring can be used to estimate noise exposure when the noise levels are relatively constant and employees are not mobile. In workplaces where employees move about in different areas or where the noise intensity tends to fluctuate over time, noise exposure is generally more accurately estimated by the personal monitoring approach.

In situations where personal monitoring is appropriate, proper positioning of the microphone is necessary to obtain accurate measurements. With a dosimeter, the microphone is generally located on the shoulder and remains in that position for the entire workday. With a sound level meter, the microphone is stationed near the employee's head, and the instrument is usually held by an individual who follows the employee as he or she moves about.

Manufacturer's instructions, contained in dosimeter and sound level meter operating manuals, should be followed for calibration and maintenance. To ensure accurate results, it is considered good professional practice to calibrate instruments before and after each use.

HOW OFTEN IS IT NECESSARY TO MONITOR NOISE LEVELS?

The amendment requires that when there are significant changes in machinery or production processes that may result in increased noise levels, re-monitoring must be conducted to determine whether additional employees need to be included in the hearing conservation program. Many companies choose to re-monitor periodically (once every year or two) to ensure that all exposed employees are included in their hearing conservation programs.

WHERE CAN EQUIPMENT AND TECHNICAL ADVICE BE OBTAINED?

Noise monitoring equipment may be either purchased or rented. Sound level meters cost about $500 to $1,000, while dosimeters range in price from about $750 to $1,500. Smaller companies may find it more economical to rent equipment rather than to purchase it. Names of equipment suppliers may be found in the telephone book (Yellow Pages) under headings such as: "Safety Equipment," "Industrial Hygiene," or

"Engineers-Acoustical." In addition to providing information on obtaining noise monitoring equipment, many companies and individuals included under such listings can provide professional advice on how to conduct a valid noise monitoring program. Some audiological testing firms and industrial hygiene firms also provide noise monitoring services. Universities with audiology, industrial hygiene, or acoustical engineering departments may also provide information or may be able to help employers meet their obligations under this amendment.

Free, on-site assistance may be obtained from OSHA-supported state and private consultation organizations. These safety and health consultative entities generally give priority to the needs of small businesses.

Appendix H - Availability of referenced documents

Paragraphs (c) through (o) of 29 CFR 1910.95 and the accompanying appendices contain provisions which incorporate publications by reference. Generally, the publications provide criteria for instruments to be used in monitoring and audiometric testing. These criteria are intended to be mandatory when so indicated in the applicable paragraphs of 1910.95 and appendices.

It should be noted that OSHA does not require that employers purchase a copy of the referenced publications. Employers, however, may desire to obtain a copy of the referenced publications for their own information.

The designation of the paragraph of the standard in which the referenced publications appear, the titles of the publications, and the availability of the publications are as follows:

Paragraph Designation	Referenced Publication	Available from --
Appendix B	"List of Personal Hearing Protectors and Attenuation Data" HEW Pub. No. 76-120, 1975. NTIS-PB267461	National Technical Information Service, Port Royal Road, Springfield, VA, 22161
Appendix D	"Specification for Sound Level Meters" S1.4-1971 (R1976)	American National Standards Institute, Inc., 1430 Broadway, New York, NY, 10018
1910.95(k)(2), Appendix E	"Specification for Audiometers," S3.6-1969.	American National Standards Institute, Inc., 1430 Broadway, New York, NY, 10018
Appendix D	"Specification for Octave, Half-Octave and Third-Octave Band Filter Sets," S1.11-1971 (R1976)	Back Numbers Department, Dept. STD, American Institute of Physics 333 E. 45th St., New York, NY, 10017; American National Standards Institute, Inc., 1430 Broadway, New York, NY, 10018

The referenced publications (or a microfiche of the publications) are available for review at many universities and public libraries throughout the country. These publications may also be examined at the OSHA Technical Data Center, Room N2439, United States Department of Labor, 200 Constitution Avenue, NW., Washington, DC 20210, (202) 219-7500 or at any OSHA Regional Office (see telephone directories under United States Government - Labor Department).

Appendix I - Definitions

These definitions apply to the following terms as used in paragraphs (c) through (n) of 29 CFR 1910.95.

Action level - An 8-hour time-weighted average of 85 decibels measured on the A-scale, slow response, or equivalently, a dose of fifty percent.

Audiogram - A chart, graph, or table resulting from an audiometric test showing an individual's hearing threshold levels as a function of frequency.

Audiologist - A professional, specializing in the study and rehabilitation of hearing, who is certified by the American Speech-Language-Hearing Association or licensed by a state board of examiners.

Baseline audiogram - The audiogram against which future audiograms are compared.

Criterion sound level - A sound level of 90 decibels.

Decibel (dB) - Unit of measurement of sound level.

Hertz (Hz) - Unit of measurement of frequency, numerically equal to cycles per second.

Medical pathology - A disorder or disease. For purposes of this regulation, a condition or disease affecting the ear, which should be treated by a physician specialist.

Noise dose - The ratio, expressed as a percentage, of (1) the time integral, over a stated time or event, of the 0.6 power of the measured SLOW exponential time-averaged, squared A-weighted sound pressure and (2) the product of the criterion duration (8 hours) and the 0.6 power of the squared sound pressure corresponding to the criterion sound level (90 dB).

Noise dosimeter - An instrument that integrates a function of sound pressure over a period of time in such a manner that it directly indicates a noise dose.

Otolaryngologist - A physician specializing in diagnosis and treatment of disorders of the ear, nose and throat.

Representative exposure - Measurements of an employee's noise dose or 8-hour time-weighted average sound level that the employers deem to be representative of the exposures of other employees in the workplace.

Sound level - Ten times the common logarithm of the ratio of the square of the measured A-weighted sound pressure to the square of the standard reference pressure of 20 micropascals. Unit: decibels (dB). For use with this regulation, SLOW time response, in accordance with ANSI S1.4-1971 (R1976), is required.

Sound level meter - An instrument for the measurement of sound level.

Time-weighted average sound level - That sound level, which if constant over an 8-hour exposure, would result in the same noise dose as is measured.

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